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Monitoring the lorry environment during transportation of day-old chicks.

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Agricultural Memorandum No. 1074

Summary:

Day-old broiler chicks are quite resilient to being transported although heat stress, even for short periods (~1 hour), can depress live-weight gain (while not affecting subsequent mortality rates).

Detailed logging of temperature and relative humidity in a chick-transporter lorry over periods of about an hour, from loading at a Welsh hatchery to discharge at a finishing farm, showed that the environment, even within container baskets, remained well within acceptable limits. 'Environmental control' was achieved by ventilation crudely controlled by the driver from temperature readings on dials near the cab.

Introduction:

Agricultural Memorandum 1068 described a preliminary study, in co-operation with a North Wales hatchery*, of the environment of a chick-transporter lorry. The need for an observer to travel with the lorry and for short time-intervals (~10secs) between readings was noted at the time and,in this Memorandum,the monitoring procedure follows that methodology.

Four times a week day-old chicks are transported by lorry from a chick holding room (at carefully monitored temperature and humidity) to various finishing farms located within twenty kilometres from the hatchery; sixty thousand chicks a day, over one and a half million a year -yet still only a small proportion of the four hundred million broiler chicks transported annually from hatcheries in the U.K.!

These chicks will be subject to a plethora of stimuli ranging from handling, confinement, vibration, noise etc. to factors quantifiable by meteorologists - air movement, temperature and humidity (Freeman,1984). These stimuli can also be defined as potential 'stressors' the 'climatic' factors probably being the most important. We should, however, distinguish between the 'climate' within a transporter-van and the (micro-) climate around the chick. (Freeman notes that it is suprising how little research has been done on poultry transportation and particularly the 'climatic' aspects).

This report is of a study of a lorry-container environment during two trips on the morning of 1st May 1986 to transport 60,000 day-old chicks to a 'finishing-farm'* furthest from the hatchery - a distance of 20km. by road.

Transportation and chick physiology.

Heat is lost by the chick as 'sensible' and 'insensible' heat (i.e. as water-vapour). Generally at least 75% of heat can be dissipated as sensible heat to the environment since body temperature is high (Tb=41'C). As ambient temperature, Ta, approaches this value, of course, the sensible heat flux diminishes until, at Ta=Tb, the flux is zero. The chick must then rely entirely on the cooling effect of evaporating water from the integument or from the respiratory tract - there is a significant cutaneous component, despite the lack of sweat glands.

The newly-hatched chick is a very imperfect homeotherm. Its heat production is a minimum at 35'C (when rate is about 1.3 kJ/hr); at Ta> 35'C heat production increases by 0.05 kJ/hr for each 1'C rise in Ta. At Ta< 35'C the increase is about 0.08 kJ/hr for each 1'C fall in Ta. When Ta=38'C panting is initiated and an increasing amount of heat is dissipated by the evaporative route. The 'thermal-neutral zone' is hence about 31 to 35'C ; the 'upper critical temperature' is about 45'C, the 'lower critical temperature' about 15'C (a value attained in 4 hours or so at Ta=10'C).

The day-old chick seems remarkably well suited to travel; it has ample supplies of food and water in the form of yolk and it is also resistant to many of the stressors mentioned earlier. The yolk stores of the newly-hatched chick provide about 2 gm. of fat & 2.5ml. of water; the energy content of the fat is sufficient to meet requirements for about 3 days. Provided Ta<26'C water reserves are also sufficient for for the same period.At Ta=40'C, however, these reserves are exhausted in 8-10 hours.

A temporary failure of the hypothalamic control mechanism results in the chick being relatively un-responsive to stress - particularly cold; it is responsive to heat, however (as is the adult bird). It is, therefore, more important to prevent the development of high ambient temperature and the loss of cooling when a transporter-lorry is stationary, for example, can have severe effects on the chicks, particularly if the stop is prolonged and the vehicle left in the sun. Relative humidity becomes important only when associated with high ambient temperature when the need for adequate ventilation becomes paramount.

It is,then, fortuitous (and fortunate!) that the day-old chick is so 'adapted' to transportation that losses are low (<1%). It is noteworthy, however, that Ernst et al(1984), in studies on day-old chicks, found that heat stress at 44'C for periods as short as one hour, while not lethal, significantly reduced 'the growth-rate to 16 days' **without any influence on the feed conversion ratio or subsequent mortality.** This weight-difference persisted, **no** subsequent compensatory growth-rate occurring.

The evidence seems to indicate, therefore, that while day-old chicks survive transportation effectively, 'hidden losses' in the form of subsequent loss in live-weight gain may occur.

Method:

Two 'Squirrel' data loggers were used to record the temperature in seven different locations within the chick carrying compartment of the lorry (see figs 1&2). One channel on one of the loggers was used to monitor the humidity. The location of the humidity probe was selected close to the 'cab' end of the lorry as these chicks spend the longest time on the lorry and so will experience any fluctuations in temperature and humidity for longer periods during transportation.

The locations of the sensors were selected according to, and to some extent limited by, the arrangement of the stacked baskets of chicks; figs 1&4 illustrates the stacking arrangement. The baskets, each containing 150 chicks, are stacked up to 8 high; three such stacks can be accommodated across the lorry. There is room for 5 ranks of stacks along the the body of the lorry with an unused area at the rear (by the unloading doors). The whole arrangement of baskets is held in position by a series of metal bars slotted across and down the lorry (figs. 1&4). Some 30,000 chicks can thus be transported at a time; half the number (from the baskets packed at the rear) are delivered at the first shed, the lorry then moving to the second shed to complete the delivery (Fig. 5 & table 1,xiii).

The equipment was set up and tested the day before the experiment and then set to begin recording at six second intervals from 07.30am the next day. This would give ample time for the loading of chicks delivery and return journey estimated at a maximum of two and a half hours. The Squirrel Logger will record up to 2000 readings and, at six second intervals, will run for over three hours while still providing an excellent 'resolution' for examining the various manoeuvers conducted during delivery. One of the authors (JT) travelled in the cab for the two deliveries made that day and noted the exact times of significant activities such as: loading chicks, loading completed, start of journey, arrival at farm, unloading chicks, and arrival back at the hatchery. After the first journey the loggers were interrogated and the data saved to tape (fig.6). The loggers were then reset to record the second journey (fig.7).

Environmental control in the lorry:

A bank of fans at the cab-end of the lorry on the off-side (figs. 1 & 2) forces air into the container a crude driver-controlled vent on the near-side adjacent to the fans is used to maintain the volume within an 'acceptable' temperature range, as registered on dials behind the cab connected to sensors on each side of the carrier (roughly at the centre of each side wall; Figs 1 & 4).

Results:

The output from the data loggers is presented graphically in figs.6&7 and summarised in tables 3&4.

Trip one.

The two loggers were due to start recording at 0730 BST (due to a human error one logger failed to start at the designated time and was set manually at 0828 en route) fig 6.

From 0730 to 0810 the logger recorded a constant temperature of 21.2'C (average of channel (ch.)E & ch.G) and a humidity of 45% (see table 3). As soon as the tail gate on the lorry was opened prior to loading the temperature began falling and as a consequence the humidity rose. By the time the lorry had backed into the loading bay the temperature had dropped by 8 to 11'C to an average of 12.6'C well above the ambient temperature of 8.6 'C. The relative humidity rose to 64% initially.

On loading the chicks (which had just been sprayed to guard against various diseases) the humidity rose still further to 83% This was very close to the atmospheric humidity of 88% at the time. The temperature rose to 21'C as the chicks were placed inside the container (table 1, iii)

After closing the back of the lorry the temperature rose again to an average of 25.5'C and the humidity began to fall.

When the journey to the farm began the temperature dropped slightly and remained at a constant average of 25.3'C with a standard deviation of 1.5'C. This is some 15'C above the ambient temperature of 9.0'C*. (table 5) The maximum variation from one area of the lorry to another was 8.0'C for the entire period of transport. The maximum variation in any one area though was only 4.3'C but, the relative humidity dropped to 34%! and remained there until the container was opened.

After arriving at the farm a short wait was necessary for the farmer to appear; during this period of about 5 minutes the temperature rose by about 3'C until the container was opened and directed to the appropriate shed. (table 1,ix)

As soon as unloading began the temperature fell to 12.3'C in 10 minutes; the air temperature at this time was 9.0'C. The relative humidity rose to 53% (table 3,x)

On the return journey the temperature inside the container with the vent closed and the heater off was 17.9'C and the relative humidity was 61%.

Trip Two.

Both loggers were set off manually at the same time (fig 7). The initial temperature of the container was 17.5'C and humidity 51%. The air temperature was 11.1'C and it was a sunny but windy day; the humidity was 78%. On opening the the container and backing into the loading bay the temperature dropped to 13.2'C and humidity rose to 66%.

As the chicks were loaded the temperature rose to 22'C then to 27'C after the container was closed. Before departure the humidity went up to 60% then dropped rapidly to 30% ten minutes into the journey. In this time the temperature also fell by about 4'C to an average of 24'C for the entire journey. The ambient temperature during transport was about 11'C.(see table 5). The variation at any location was 3.8'C at the most; the humidity was between 24 and 32%.

There was a small rise of about 2'C while waiting for the farmer to appear at the finishing farm. On unloading the chicks at the first shed the temperature around the chicks remaining in the container (destined for the second shed) fell to 25.4'C then after after this batch of chicks was unloaded the temperature dropped to 15'C (at 1210), the air temperature at the time being 11.3'C. (table 5)

On the return journey the maximum temperature attained with the vent closed and the container heater on was 23.0'C

The Chick as a Wet Bulb

Prior to loading the first batch of chicks, all chicks (1st and 2nd batches) are sprayed as a protection against various ailments. The first batch thus enter the lorry moist and this, in conjuntion with the respiratory output is reflected in the rise in relative humidity (RH) to 65% when loading is completed and the back closed (table 3 0824 - 0828)

During transportation the moist chicks will be subject to forced ventilation and for a time therefore will behave as 'wet - bulbs'; the pelage will have a temperature depressed below the dry-bulb value. The RH (channel F) fell from 65% to 38% over the first ten minutes and the temperature (channel G) quickly levelled off at about 25'C. Initially the wet-bulbs were at about 20'C ie. well above the lower critical temperature of 15'C.

The chicks were dry on arrival at 0905 so the RH of 38% represents the equilibrium RH and presents the potential hazard of dehydration on a longer journey.

The second batch of chicks had dry pelage at the time of loading and subsequently after the back was closed the RH rose briefly due to respiration and fell quickly to about 30% as ventilation became effective.(see table 4,v) The temperature was steady at about 28'C. Again dehydration is a potential hazard on longer journeys and a humidifier may be necessary.

Conclusions

1 The study illustrates the value of a compact, multi-channel data logger as an advisory tool in monitoring environments; interpretation of data though, certainly requires a concurrent, carefully kept diary of events or actions influencing that environment.

2 Although the chicks are kept under carefully controlled conditions, the transport aspect is open to less controllable inputs, such as solar heating and reduced ventilation when the lorry is stationary etc. When associated with the crude environmental control available on these lorries, these factors could prove potentially damaging to chick well-being.

3 In the studies however, the environment stayed within satisfactory temperature limits (though the outside temperature was only between 9 and 12'C). The relative humidity attained low levels that, on a longer journey, could subject the chick to dehydration.

4 The data show that the temperature within the lorry plunged sharply when the doors are open for loading. In cold weather the chicks, especially the initial wetted batch, will thus be subjected to sharp temperature changes on moving from the hatchery during loading and then again when the doors are shut and the lorry moves off. Similar temperature fluctuations will be imposed on off-loading.

The authors hope to repeat the studies at another hatchery where long journeys to finishing farms are necessary, ideally monitoring under very warm and very cold conditions.

Acknowledgements:

The studies were carried out with the co-operation of the Hatchery Manager* and the advice of Mr R King, Regional Poultry Adviser.

* : Anonymity of the enterprise has been preserved for commercial reasons.

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Agricultural Memorandum 1068

Any comments or suggestions on this paper should be sent to the authors.

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July 1986

Table 1 **Activities during first journey 1st May 1986**

Time (BST)		Activity
0800	i	Electric heater switched off and van engine started.
0810	ii	Van moved to loading bay. (a distance of about 50 yards)
0813	iii	Engine off. loading of chicks begun. (Chicks shipped through side door)
0819	iv	Nine 'columns' of chicks now loaded. (second drop)
0822	v	Last two 'columns' of chicks loaded.
0823	vi	Engine switched on. Lorry pulls forward a few yards.
0824	vii	Back of lorry closed. Journey to finishing farm begins
0828	viii	(En-route) Fault noticed on one logger and is reset.
0905	ix	Arrive at farm. Wait for farmer to direct to appropriate shed.
0910	x	Back opened on lorry.
0913	xi	First chicks unloaded
0919	xii	First unloading completed. Lorry moves to the next shed
0921	xiii	Begin unloading second lot of chicks. Fans switched off.
0928	xiv	Lorry empty.
1015	xv	Arrive back at Hatchery

Table 2 **Activities during second journey 1st May 1986**

Time (BST)		Activity
1046	i	End of coffee break
1050	ii	Empty crates unloaded.
1056	iii	Backing into loading bay
1104	iv	All chicks loaded. Lorry pulls forward.
1105	v	Back of lorry closed. Depart.
1135	vi	Vent on Lorry opened fully to assess effect.
1140	vii	Vent now operated normally.
1145	viii	Arrive at Farm.
1149	ix	Start unloading chicks.
1158	x	Move to next shed.
1201	xi	Start unloading second batch.
1210	xii	Second batch unloaded Lorry now empty.
1233	xiii	Heater switched on to assess effects. Vent kept closed.
1243	xiv	Vent opened.
1255	xv	Vent closed again.
1305	xvi	Arrive at Hatchery.

Table 3 Trip one

TIME / ACTIVITY (SEE TABLE 1)

	i	ii,iii	iv,v	vi-viii	ix	x-xiii	xiv,xv
CHANNEL	0809	0816	0822	0828	TRANSPORTING	UNLOADING	RETURN
A	---	--	---	---	23.3-27.6	11.0	17.5
B	---	--	---	---	24.9-26.5	11.0	17.5
C	---	--	---	---	20.6-24.4	13.7	17.9
D	---	--	---	---	23.0-26.0	13.2	17.7
E	20.0	12.0	21.0	27.0	25.0-28.0	11.0	17.9
F	45%	64%	64%	55%	65%-38%	53%	61%
G	22.2	13.2	21.2	25.9	25.9-28.6	12.7	18.5

Table 4 Trip two.

TIME / ACTIVITY (SEE TABLE 2)

	i	ii,iii	iv	v	vi,vii	viii-xi	xii	xiii	xiv
CHANNEL	1046	1055	1105	1110	TRANSPORTING	UNLOADING	RETURN*		
A	17.4	13.2	21.2	27.0	23.3-27.0	20.1^{d1} 14.8^{d2}	14.8	22.8	19.0
B	16.9	13.2	24.9	29.1	30.0-35.0+	32.9^{d1} 14.2^{d2}	14.2	23.8	19.6
C	17.4	15.8	20.1	24.4	20.6-24.4	20.1^{d1} 15.8^{d2}	17.4	23.8	19.6
D	17.4	13.2	22.8	24.9	24.4-27.0	23.3^{d1} 16.4^{d2}	15.3	22.2	19.0
E	18.0	16.4	24.9	29.1	27.0-29.0	25.4^{d1} 16.1^{d2}	17.4	22.2	19.0
F	51%	66%	47%	30%	24%-32%	$30\%^{d1}$ $35\%^{d2}$	45%	36%	40%
G	18.0	14.3	21.2	29.0	28.1-30.7	25.4^{d1} 14.3^{d2}	16.4	23.0	19.0

^{d1} refers to the temperature / humidity after the delivery to the first shed.
^{d2} refers to the temperature / humidity after the delivery to the second shed.

Table 5

Table showing temperature and humidity at a local synoptic station*

Time(BST)	Relative Humidity	air temp 'C
0600	90%	8.3
0700	88%	8.4
0800	88%	8.6
0900	85%	9.0
1000	82%	10.2
1100	78%	11.1
1200	74%	11.3
1300	68%	12.0
1400	64%	11.8

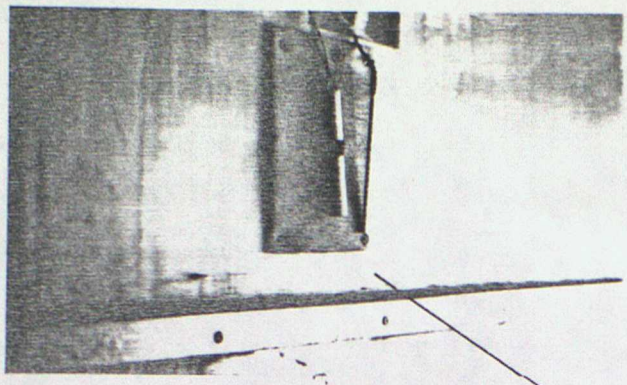
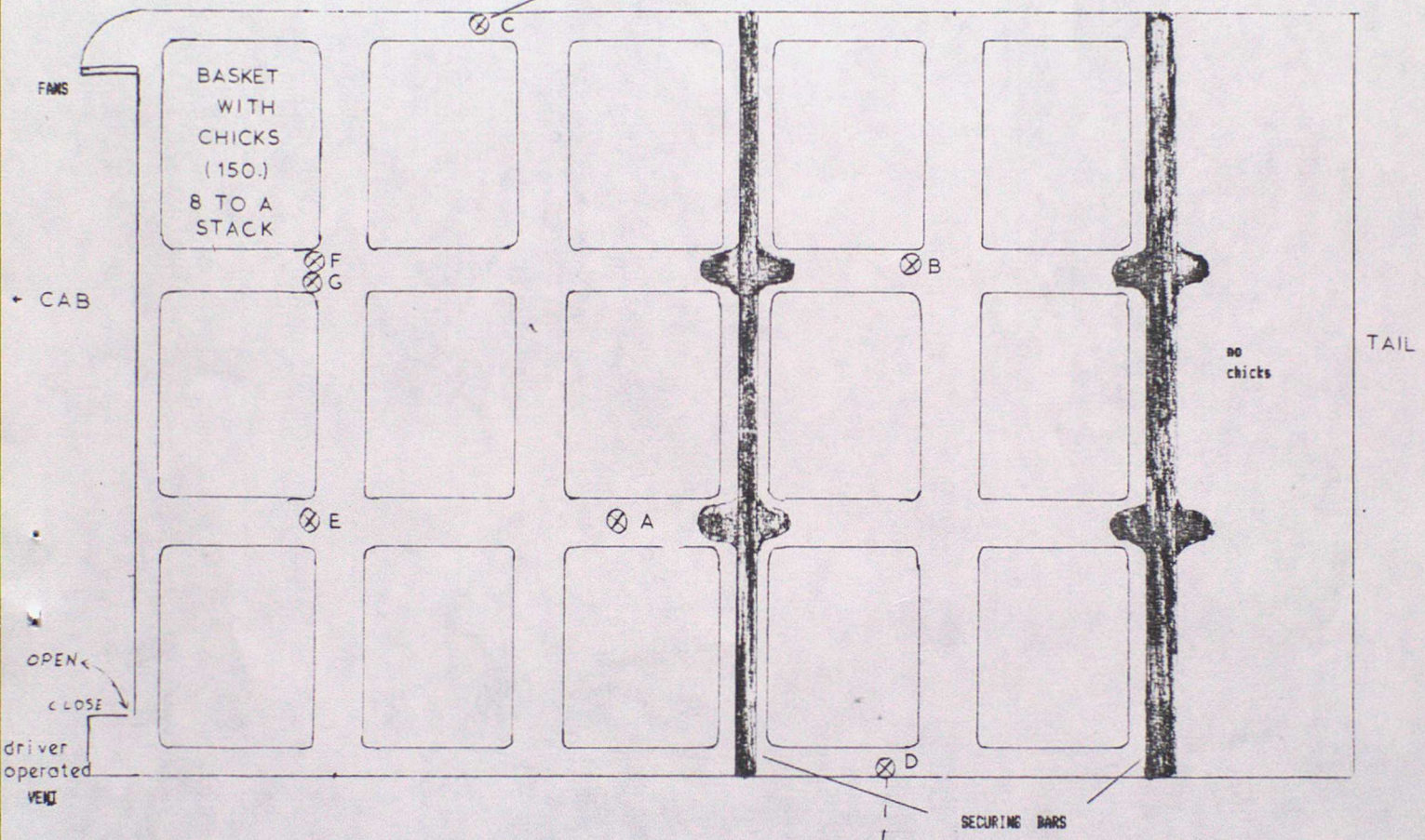


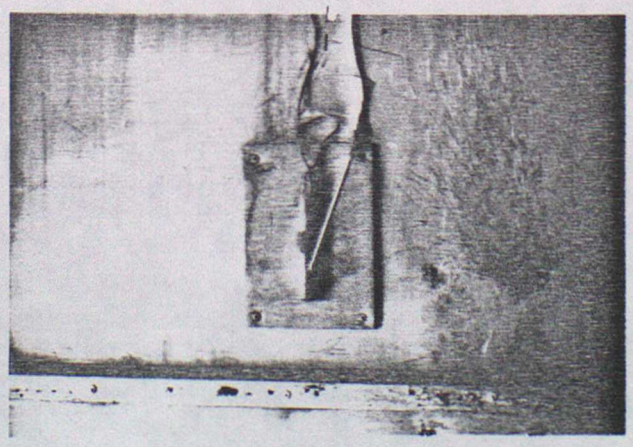
Fig 1

DIAGRAM SHOWING THE LOCATION OF THE TEMPERATURE PROBES AND HUMIDITY SENSOR

PROBE 'C' WITH CAB TEMPERATURE PROBE



PROBE 'D' ALONGSIDE FIXED PROBE FOR DRIVER'S MONITOR BEHIND CAB →



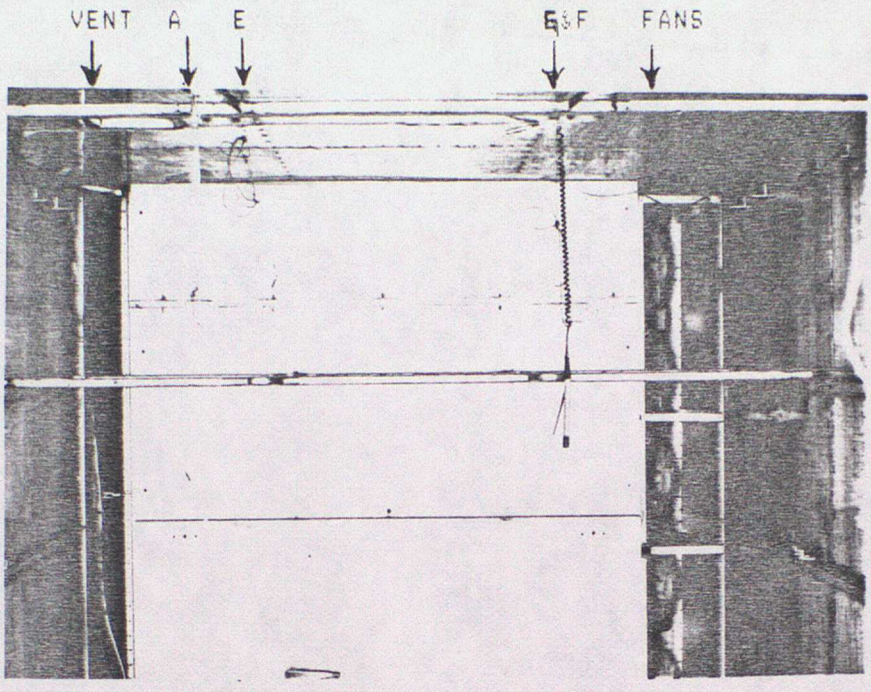


Fig 2: Looking towards cab.
R Centre: Temperature and humidity probes G & F
L Centre: temperature probes A & E

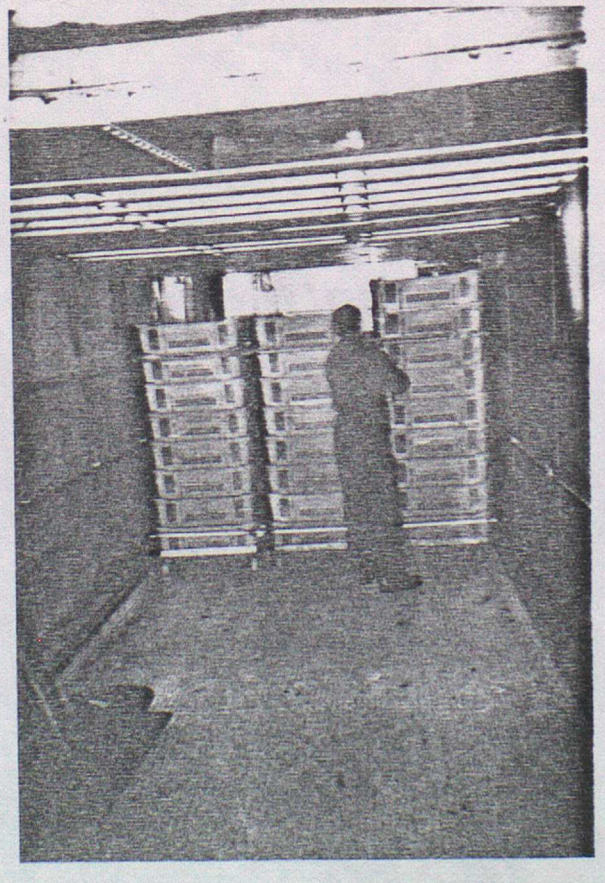


Fig 3.
loading Baskets containing 150 chicks stacked 8 to a column in three rows across width of lorry.

Fig 4:
Stacked baskets with positioning bars

Left: Temperature probe D and lorry temperature probe.

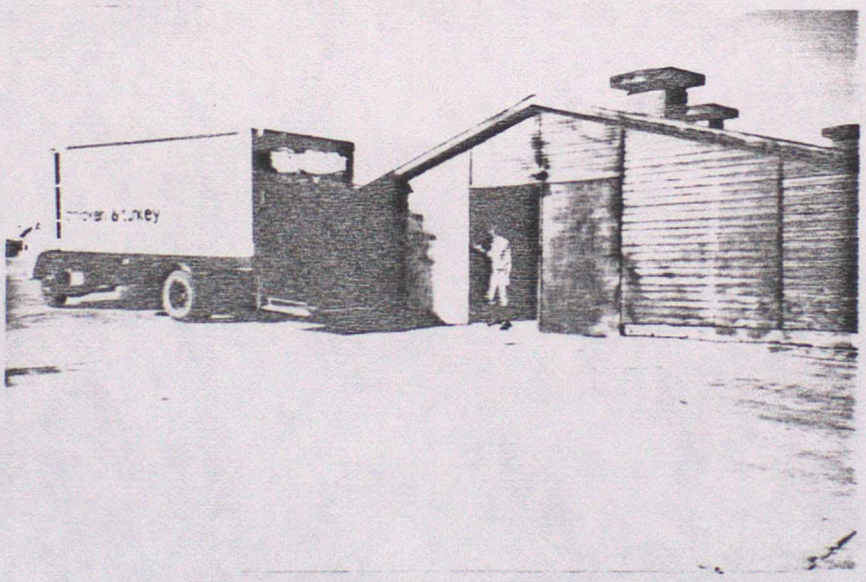


Fig 5.
Delivery at the first shed 0910 BST 1st May 1986

Fig 6 First journey to finishing farm
0730 - 1025

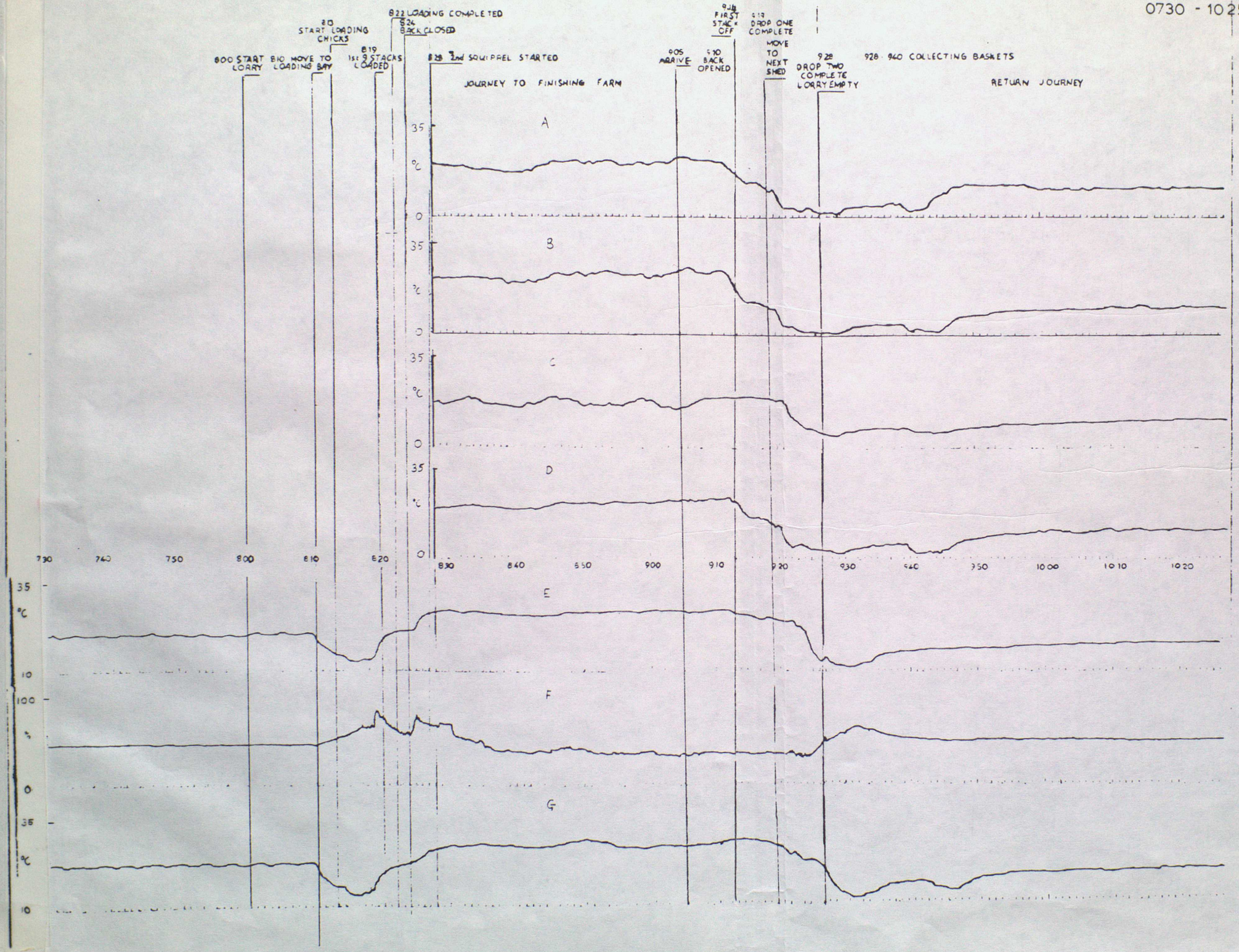


Fig 7 Second journey to finishing farm

1045-1300